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ABSTRACT

This paper examines the origins of the principle of free expression as worked out by Galileo. It is intended to supplement standard histories of the development of free expression and to recover its history as part of the political project of postmodernism. The paper resurrects Galileo's encounters with entrenched beliefs in order to position free expression historically as an ideal that arose with the secularization of thought and the birth of modern science in the seventeenth century. Noting that in many respects Galileo's worldview is distinctly premodern, the paper concludes that many of the principles first articulated by Galileo are now deeply ingrained ideals of Western culture. Eighteen references are attached. (RS)

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Foundations of an Idea: Galileo and Freedom of Expression

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Abstract

This paper examines the conflict between Galileo and authorities over heliocentrism in order to position free expression historically as an ideal that arose with the secularization of thought and the birth of modern science in the seventeenth century. After sketching the events leading up to Galileo's condemnation by the Inquisition, the paper analyzes Galileo's polemical writings in terms of his concepts of human nature, the natural world, science, knowledge, and freedom, that together constitute a basis for the modern belief in free expression.

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June twenty-second, sixteen thirty-three.
A momentous date for you and me.
Of all the days that was the one
An age of reason could have begun.
Bertolt Brecht
The Life of Galileo

The Salman Rushdie affair has dramatically underscored the cultural and historical nature of the Western concept of freedom of expression. A classic example of the perennial confrontation of intellectuals and social authorities, the case has been likened by a number of commentators to two signal events in the historical struggle for free expression--the Scopes monkey trial and the trial of Galileo (see, e.g., Dyer, 1989). The conflict between evolutionists and creationists, perhaps still not completely played out, informs contemporary discussions of freedom of expression (see, e.g., Chafee, 1941, p. 552). But the conflict between heliocentrists and geocentrists has long been resolved, and the Galileo affair is kept alive only by historians and philosophers of science. For scholars of freedom of expression, Galileo is remembered only as the old prisoner of the Inquisition wistfully recalled by Milton in the Areopagitica.

This paper resurrects Galileo's encounters with entrenched beliefs in order to position free expression historically as an ideal that arose with the secularization of thought and the birth of modern science in the seventeenth century. The purpose of the paper is two-fold. First, the existing literature on freedom of expression (e.g., the work of Leonard Levy or Zechariah Chafee) emphasizes its roots in the political philosophy of the

eighteenth century, stretching that time frame to include Milton on one end and Mill on the other. The conventional explanation for the development of the principles of freedom of speech and of the press is that a free flow of information is a core element in liberal democratic theories of self-governance, or at least political participation, by rational individuals. While not denying that the warrant for free expression rests mainly on political grounds, the present paper is meant to supplement the standard histories by examining the origins of the principle as worked out by a founder of modern science. The immediate cause of Galileo's condemnation by the Church in 1633 was the publication of the Dialogue on the Two Great World Systems, a camouflaged defense of the Copernican system that allegedly violated a 1616 order not to defend heliocentrism.[1] But Galileo stretched the limits of authorities' tolerance from his days as a student on, and his literary corpus is laced with appeals for freedom of inquiry and expression. Beyond his continuous need to justify his beliefs and explain his logic to his opponents, Galileo was "inventing" science and its distinctive method of inquiry as he went along. He wrote in Italian for popular as well as learned audiences, taking great pains to explain how he arrived at his conclusions, to contrast science with other realms of thought, and to argue the case for freedom. Galileo's works, then, highlight the epistemology of science as the basis for free

[1] Historians still debate whether a strict injunction was issued to Galileo, and if so, whether he agreed to abide by it. See Santillana, 1955, Ch. 13, and Langford, 1971, Ch. 4.

expression.

A second purpose of the paper is to recover the history of the principle of free expression as part of the political project of postmodernism. The outrage expressed by Western intellectuals over the late Ayatollah's call for the assassination of Rushdie illustrates what Hal Foster (1983, p. xi) describes as a basic opposition within postmodernism. A "postmodernism of reaction" repudiates modernism, including such principles as freedom of expression, in order to celebrate the status quo, while a "postmodernism of resistance" deconstructs modernism and its tenets in order to resist the status quo. The Rushdie affair was a stark reminder of the reactionary implications of the contention within some strands of postmodernism that the Enlightenment is dead,[2] and it points us in the direction of a postmodernism of resistance that attempts to restore, in a form appropriate to the late twentieth century, the original oppositional intention of the Enlightenment. This article thus returns to the period before the ascendancy of bourgeois economics and liberal democratic politics to examine early modern

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[2] For a discussion of the charge that postmodernism signals the end of history and thus the end of the historical struggle for emancipation, see Hall, 1986. For a defense of postmodernism against this charge, see Kuan-Hsing Chen, 1989. He claims that for postmodernism, the "end of history" means the end of "official" history--white, male, Euro-centered--and the beginning of histories of wars against oppression (p. 14). In defense of yet another glance at a white, male, European, I can only plead that within the historical context of the seventeenth century, Galileo was in the forefront of the battle against authoritarianism. The fact that he was eventually vindicated and that science in turn became an oppressive ideology makes the initial struggle no less worthy of attention.

thoughts on rationality, toleration, and freedom of inquiry and expression.

Following a descriptive account of the events leading up to Galileo's condemnation, the paper focuses on the philosophical origins of freedom of expression as revealed in Galileo's writings, particularly his two great polemics, Letter to the Grand Duchess Christina and The Assayer. The framework for analyzing these writings is an adaptation of a model developed by Jay Jensen in his intellectual history, Liberalism, Democracy and the Mass Media. Following Jacob Burckhardt, Jensen's work is an attempt "to link up a number of observations about myth-systems which have shaped the intellectual temper of the modern epoch to the multiple series of cultural and sociological events which have shaped the institutional order of the contemporary world" (Jensen, 1976, p. 9).

Jensen's theory of the relationship between ideas and history rests on four assumptions. He writes (pp. 8-9),

> First, I assume that ideas represent a real...force in the determination of human events. Second, that ideas are actualized in history by the formation of myth-systems...Third, that the myth-systems of any culture have a reciprocally influential relationship with the institutional order of, and individual behavior in, that culture...Fourth, that in the historical development of the reciprocal relationship between myth-systems and social-cultural conditions there is an

observable pattern, or order, that is subject to description.

Jensen (pp. 9-10) lists eight variables that he uses in analyzing the reciprocal relationship between myth-systems and institutional orders: "1) the theory or concept of the universe, i.e., the world-view or image of Reality; 2) of the Individual, or Self; 3) of Freedom; 4) of knowledge and/or Truth; 5) of Social Order; 6) of Moral Order; 7) of Law; and 8) of Political Economy." He sees this set of categories as heuristic, and presents it as a tentative, flexible model for understanding the historical process.

By slightly modifying Jensen's model, we can identify five categories that are relevant for organizing the cluster of ideas that constitute Galileo's theory of freedom of expression: 1) a theory or concept of human nature; 2) of nature; 3) of science; 4) of knowledge and truth; and 5) of freedom. As Jensen (1976, p. 10) explains, the definition of such concepts, mutually influenced by socio-cultural conditions, shapes the character of a given worldview and largely determines the basic institutional order of a given social group.

We are more interested in the history of an idea--freedom of expression--than the history of an individual--Galileo. But the justification for a biographical approach stems from the work of Jensen's mentor, Burckhardt, who approves of the study of world movements as they are formulated or embodied by individuals. He writes, "Peoples, cultures, religions, things,

whose significance seemed to reside only in their totality, which seemed to be only the products and manifestations of that totality, are suddenly given a new content or a commanding expression by great individuals" (Burckhardt, 1943, p. 307). In accordance, then, with Burckhardt's (1943, p.308) belief that "all the great things of the mind undeniably live by virtue of their great representatives," we turn to Galileo and the moment in history when the characteristic ideas of the modern age about freedom of expression originated. In order to establish the biographical context in which these ideas were formulated, we begin by recounting the story of Galileo's struggle with authorities.[3]

In the Age of Galileo, the accepted source of all wisdom in the realm of natural philosophy, or science, was Aristotle, and the accepted mode of inquiry was exegesis. Both universities

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[3] The literature on Galileo's struggle against authoritarianism is vast. Most contemporary accounts are correctives to the nineteenth century tendency to treat the affair as a collision between enlightened science and encrusted faith. Santillana (1955), certainly no apologist for the Church, believes Pope Urban and his counselors have been unfairly cast as "bigoted oppressors of science" (p. 2). He sees both Galileo and the Church hierarchy as victims of an intrigue engineered by a group of obscure, jealous individuals (p. xiii). Koestler (1959) admits that he sees Galileo as an "unattractive" figure in the history of science, mainly because of his inexplicable snubbing of Kepler and his theory of elliptical orbits. Still, Koestler understands the hostility between Galileo and authorities as "a clash of individual temperaments aggravated by unlucky coincidences" (p. 426). Langford (1971), a Catholic priest, concedes that the condemnation was a mistake, but presents a compelling argument that Galileo forced the Church into a corner by insisting on the premature acceptance of his theories. Lindberg and Numbers (1986) describe the affair as an intramural dispute within the Church over the right of individuals to interpret the scriptures.

and the Church held an Aristotelian-Ptolemaic theory of the universe, according to which the earth is motionless, at the center of the universe, and all celestial bodies circle around it. A generation earlier, Copernicus had advanced his alternative theory, which placed the sun in the center of the universe and reduced the earth to the status of a planet. Over the years, the Copernican system had a number of supporters. It provided a more elegant explanation for the observable movements of heavenly bodies, and was actually used by the Church to reform the calendar. In spite of its practical application, however, the Copernican system was officially regarded as a hypothesis. Galileo became convinced early on in his scientific career that Copernicus's theory of the universe accurately described physical reality, and the proof of its validity became the great passion of his life (Langford, 1971, p. 39).

Galileo first obtained evidence that weakened the geocentric theory of the universe in 1610. Following the invention of the telescope by a Dutchman in 1608, Galileo built several of his own, including one that was powerful enough to explore the heavens. His most important discovery was the satellites of Jupiter. For the first time, it was definitely established that a celestial body moves around a body other than the earth (Langford, 1971, p. 40). Politically astute, Galileo named the moons after the Medicis and dedicated his publication of the discovery, Starry Messenger, to Cosimo II de Medici, the Grand Duke of Tuscany. The discovery was met with great

excitement throughout Europe, tempered by some jealousy among Galileo's rivals and recalcitrance among university Aristotelians. Despite conservative currents associated with the Counter-Reformation, the Church was a more progressive institution than the university.[4] Backed by Jesuit astronomers who had confirmed his discoveries, Galileo traveled to Rome where he was celebrated by the church hierarchy. Finally, Galileo secured an appointment as court mathematician and philosopher to Cosimo, which allowed him to leave university teaching and devote all his time to science.

Shortly thereafter, Galileo was drawn into a bitter dispute with a Jesuit astronomer, Christopher Scheiner, over sunspots. Each mistakenly claimed to have discovered the phenomenon, and in an exchange of letters they disagreed sharply over their nature and location. The significance of this episode is two-fold: First, Galileo's antagonism of a member of the powerful Jesuit order strengthened the position of conservative elements in the Church and made the defense of Galileo by his liberal supporters more difficult. Secondly, in the widely circulated Letters on Sunspots, the published version of his

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[4] The Age of Galileo was a low point for the universities. As Drake notes, Galileo's desire to leave the university and place himself under the sponsorship of nobility seems curious today. But in Galileo's time, universities "could be counted on to combat anything new or discordant with tradition. A man who found himself in the possession of new and startling truths today would consider a governmental position, especially under a dictator, far less attractive than a professorship, but at that time the patronage of some benevolent despot was likely to be the only hope" (Drake, 1957, p. 72).

letters to Scheiner, Galileo for the first time publicly endorsed the Copernican system as a reality rather than a mere hypothesis, and offered up his own discoveries as proof. As Drake (1957, p. 85) writes, "Galileo's Letters on Sunspots thus brought the question of the earth's motion to the attention of practically everyone in Italy who could read."

The controversy over the Copernican system became a popular topic of conversation. In an incident that turned out to be of crucial importance in Galileo's career, the "new astronomy" came up during the course of a dinner given by Galileo's patron, Cosimo, in late 1613. Galileo was not present, but his views were explained by his disciple, Benedetto Castelli, a Benedictine monk who taught mathematics at the University of Pisa. As Castelli recounted the event in a letter to Galileo a couple of weeks later, he handled himself well in the conversation, and apparently satisfied his interlocutors. But he had no sooner left the palace than he was called back by Cosimo's mother, the Grand Duchess Christina, and interrogated about scriptural objections to the Copernican system raised by another guest, Cosimo Boscaglia, a Peripatetic professor.[5] Again, Castelli rose to the occasion: "I commenced to play the theologian with such

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[5] Santillana (1955, p. 40) identifies Boscaglia as a peripheral member of the "pigeon league" of anti-Galileans. The ringleader was Lodovico delle Colombe, an amateur philosopher and astronomer whose works Galileo would not dignify by responding to. "Colombe" translates into "pigeon"; hence, the nickname by Galileo's followers for their opponents. Drake (1957, p. 79) claims Colombe was the model for Simplicio, the simple-minded Aristotelian in the Discourse on Two Great World Systems.

assurance and dignity that it would have done you good to hear me" (Drake, 1957, p. 152). Only the Grand Duchess (whom Koestler [1959, p. 433] has described as bossy, talkative, and scatterbrained) and Boscaglia remained unmoved.

Up until that point, Galileo had managed to brush aside the theological implications of the Copernican system. But its conflict with the scriptures was now an issue, and Galileo too was forced to "play the theologian." He set forth his views on the relationship between science and religion in his 1614 Letter to Castelli, revised and expanded the following year into the Letter to the Grand Duchess Christina.[6] Though the Letter to the Grand Duchess was not published for some years, it was widely circulated in manuscript form and hastened the drawing of battlelines. We will return to the Letter to the Grand Duchess in our analysis of Galileo's writings. For now, it is enough to register Koestler's (1959, p. 434) assessment of its significance: "Its purpose was to silence all theological objections to Copernicus. Its result was the precise opposite: it became the principal cause of the prohibition of Copernicus,

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[6] Essentially, Galileo argued in the letters that science and theology deal with the separate realms of nature and salvation, and are never at odds. Apparent contradictions stem from the use of figurative expressions in the Bible, or the limitations of our scientific knowledge at any given time. Santillana (1955, p. 98) notes that this has been the Church's official position since the late nineteenth century. Even at the time the letters were written, the views may have been controversial, but they were not heretical. The Letter to Castelli was submitted by Niccolo Lorini, a Dominican with whom Galileo had had minor skirmishes, to the Inquisition in Rome, where it was judged to be within the boundaries of acceptable expression (Langford, 1971, p. 57).

and of Galileo's downfall."

Soon after he issued this manifesto, Galileo received unexpected and welcome support when a Carmelite priest, Paulo Antonio Foscarini, published a work defending the Copernican system against charges that it was inconsistent with the Bible. Stillman Drake (1957, p. 161) speculates that the unequivocal support of a respected theologian may have been the crucial factor in Galileo's subsequent decision to press for acceptance of the Copernican system. But when Foscarini sent a copy of his book to the Church's chief theologian, Cardinal Bellarmine, and asked for his opinion, Bellarmine's response indicated that the Church had not softened its position: It is acceptable to state that the earth moves and the sun stands still for the purpose of "saving appearances," that is, explaining observable movements of heavenly bodies. So far, Bellarmine continued, there has been no "true demonstration" that the sun is in the center of the universe and the earth circles the sun. When such a demonstration is made, the Church will reconsider its stance. Until then, the scriptural passages "that the sun is in the heavens and moves swiftly around the earth, and that the earth is far from the heavens and stands immobile in the center of the universe" should be interpreted literally (Langford, 1971, pp. 60-61).

Bellarmine's appraisal of Foscarini's book was an unmistakable warning to Galileo and his followers that the Copernican system could only be discussed hypothetically.

Despite the admonition, Galileo decided the time was ripe to press for its acceptance as fact. Against the advice of his friends, he traveled to Rome in late 1615, aware that patience was running thin among the church hierarchy, but apparently confident of his persuasive abilities. By all accounts, Galileo was a social smash but unsuccessful in generating scientific understanding (see Santillana, 1955, pp. 115-116). Pope Paul V decided to end the controversy once and for all, and in February of 1616 called for an official ruling on the propositions that the sun is the center of the universe and does not move, and that the earth is not the center of the universe and does move. The propositions were censured, and Galileo was personally instructed by Bellarmine not to hold, teach, or defend such opinions. An unsigned document, thought by some historians to be a forgery, records that Galileo so promised. His breach of this promise was the gravamen of the charge against him in 1632 (Taylor, 1938, p. 94).[7]

Galileo returned to his native Florence, disappointed by the setback. He kept a low profile for the next couple of years, until the appearance of three large comets in 1618 presented him with an irresistable temptation to pick up his pen once again. Astronomers were still uncertain about the origin, nature, location, and movements of comets. Aristotle had taught

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[7] A week later, at the next meeting of the Inquisition, Foscarini's book was condemned and Copernicus's De Revolutionibus Orbium was prohibited until it could be "corrected." After minor revisions, De Revolutionibus was removed from the Index in 1620 (Taylor, 1938, p. 94).

that comets are earthly vapours, located in the sublunar region, but Tycho Brahe had undermined this traditional belief in 1577, when he demonstrated that they are located far beyond the moon. The year after the three great comets, a Jesuit astronomer, Horatio Grassi, published a series of lectures based on his observations, which essentially supported Tycho. He claimed that comets move in regular orbits, like planets, somewhere in the region of Venus. Historians disagree in their accounts of Galileo's reaction to Grassi's work.[8] What is clear is that Galileo felt compelled to respond. Because he was in no position to stir up a dispute, he accepted the offer of his disciple, Mario Guiducci, to publish his arguments under Guiducci's name. The result was the 1619 Discourse on Comets, a mild criticism of existing theories of comets, including those of Tycho and Grassi. Following Galileo's lead, Grassi adopted the pseudonym Lothario Sarsi for his response, The Astronomical and Philosophical Balance. In The Balance, which Drake calls a "bitter and slashing attack," Grassi baited Galileo, daring him to come out in favor of the Copernican system (Langford, 1971, p. 108).

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[8] Koestler (1959, p. 467) claims that despite the fact that Galileo had never written about comets, except to casually endorse Tycho, he flew into a rage when he read Grassi's treatise because he was not mentioned. In a perverse attempt to discredit Grassi, he reversed his earlier endorsement of Tycho and argued that comets are optical illusions that appear in the sky past the moon. Langford (1971, p. 107) writes that Galileo claimed comets are not celestial bodies, but are optical phenomena located in the upper atmosphere. Drake (1957, p. 220) more cautiously claims there is little historical evidence about the episode, and admits that his account is necessarily conjectural. He does dispute the contention of some historians that Galileo believed comets are located close to the earth (Drake, 1957, p. 227n).

Galileo accepted the challenge, and wrote what historians claim is the greatest polemic in the history of science, The Assayer (Drake, 1957, p. 227). Published in 1623, The Assayer is both a treatise on the philosophy of science and a devastating rebuttal. Santillana (1955, p. 157) writes that Galileo

> ...nailed the enemy to the post. Sparkling wit and destructive irony took the place of the weapons that had been forbidden. In a seemingly leisurely and impersonal excursion over the wide--too wide--field of "Sarsi's" utterances and references, Galileo went to work on learned nonsense and academic prejudice and brought forth what has remained in history as a breviary of the scientific method.

The Assayer was a stunning literary success. Galileo's stinging sarcasm and fighting spirit delighted his supporters, including the recently elected Pope Urban VIII, an old friend and the dedicatee of the book. However, from the point of view of his opponents, Galileo's lampoon of a respected Jesuit was a humiliating experience that would not be forgiven.

To wrap up this sketchy account, Galileo spent the next several years working on the Dialogue on the Two Great World Systems. He was getting old, his health was poor, and the work proceeded by fits and starts. Galileo completed the Dialogue in 1630, and after a fair amount of maneuvering with the licenser, secured an imprimatur and published the work in 1632. The Dialogue is written in the form of a conversation among three

characters: Salviati, who represents Galileo and presents the case for the Copernican system; Simplicio, a simple-minded proponent of the Ptolemaic system; and Sagredo, an unbiased observer. While the work is offered as an impartial assessment of two theories of the universe, it is a thinly veiled argument in favor of heliocentrism.

In spite of the fact that it had been vetted and approved, the Dialogue was banned several months later, and Galileo was called to Rome to stand before the Inquisition. The simplest explanation for this reversal of the authorities' longstanding toleration of Galileo is that his enemies were able to convince Pope Urban that Simplicio was a caricature of him. The Pope was greatly offended, convinced that Galileo had literally made a fool of him (Santillana, 1955, p. 195). Galileo was brought to trial in 1633 and found guilty of violating the 1616 injunction not to teach, hold, or defend Copernican opinions. At age 69, he was condemned for his heretical beliefs, forced to abjure, and sentenced to house arrest for the remainder of his life. He was allowed to return to his villa near Florence, where he continued to work despite his ill health and loss of sight. The Dialogue was published in Strasbourg in 1635, and a second monumental work, the Discourse on Two New Sciences, was published in Leyden in 1638.

The most striking aspect of this story is the interweaving of Galileo's scientific work into a tapestry of intrigue, suspicion, and rumor. As Ernan McMullin points out, for an

individual as committed to his vision as Galileo, the proof of theorems becomes secondary to the persuasion of people. McMullin (1967, p. 4) writes, "Most of his professional life was spent not in observing, not in calculating, not in proving, but simply in persuading." Against this baroque backdrop, we turn now to Galileo's writings, extracting from them his concepts of human nature, the natural world, science and religion, knowledge and truth, and freedom, that together constitute an argument for free expression.[9]

While the characterization of man as a rational being is associated with eighteenth century thought--Locke's seminal essay actually appeared in 1690--the modern concept is unmistakably foreshadowed in Galileo's writings. His assertions that man is capable of rational thought appear frequently in the context of diatribes against the irrationality of his opponents. For while Galileo has faith in man's potential rationality, he encounters a

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[9] As is the case with literature on the trial of Galileo, literature on his contributions to Western thought is enormous. Most works, of course, deal with his philosophical, theoretical, and methodological contributions to the history of science. Ernan McMullin's edited volume, Galileo: Man of Science, gives the reader a sense of the array of perspectives from which Galileo's science has been studied. See especially McMullin's introduction, with his splendid description of the allure of Galileo as a legendary figure and his outline of Galileo's scientific beliefs and discoveries. This volume also contains McMullin's update to 1964 of the standard bibliography of works on Galileo, which numbers close to 6,000 entries. The work that is most closely concerned with the issues addressed in this article is F. Sherwood Taylor's Galileo and the Freedom of Thought, a highly readable biography that presents a rich account of the religious and political climate of the period. As far as I can determine, the present article is the first to address specifically the question of Galileo and freedom of expression.

great deal of evidence that it is not widely used. As early as the 1613 Letters on Sunspots, he criticizes the Peripatetics, who classified sunspots as tiny solar planets in order to preserve the Aristotelian belief in the immutability of the celestial realm, for their refusal to look up from their texts and exercise independent intellect. He writes (Galileo, 1957c, pp. 142-143),

> It appears to me not entirely philosophical to cling to conclusions once they have been discovered to be manifestly false. These men are persuaded that if Aristotle were back on earth in our age, he would do the same--as if it were a sign of more perfect judgment and a more noble consequence of deep learning to defend what is false than to learn the truth!...It seems to me that we abase our own status too much and do this not without some offense to Nature (and I might add to divine Providence), when we attempt to learn from Aristotle that which he neither knew nor could find out, rather than consult our own senses and reason. For she, in order to aid our understanding of her great works, has given us two thousand more years of observations, and sight twenty times as acute as that which she gave Aristotle.

Though Galileo does vacillate on the question of rationality, he is generally optimistic. Addressing Sarsi in The Assayer on a question of friction, Galileo (1957a, p. 270) argues that people will trust their senses and reason against the

written opinions of a parade of poets, philosophers, and historians: "It is news to me that any man would actually put the testimony of writers ahead of what experience shows him...You take your stand on the authority of many poets against our experiments. I reply that if those poets could be present at our experiments they would change their views."

The apparent ambivalence of Galileo on the issue of human reason can perhaps be explained by the fact that at different times he wrote for different purposes. When he wanted to make the point that any educated person could follow his line of reasoning and would agree with his conclusions, he came down in favor of rationality. For example, during the sunspot exchange, Galileo noted in a letter to his friend Paolo Gualdo that Scheiner had not yet responded to one of his works, because the work had to be translated before Scheiner, a German, could read it. Galileo (Drake, 1957, p. 84) explains to Gualdo why he often writes in Italian rather than in Latin:

> I wrote in the colloquial tongue because I must have everyone able to read it...I am induced to do this by seeing how young men are sent through the universities at random to be made physicians, philosophers, and so on; thus many of them are committed to professions for which they are unsuited, while other men who would be fitted for these are taken up by family cares and other occupations remote from literature. The latter are...furnished with "horse sense," but because they

are unable to read things that are "Greek to them" they become convinced that in those "big books there are great new things of logic and philosophy and still more that is way over their heads." Now I want them to see that just as nature has given to them, as well as to philosophers, eyes with which to see her works, so she has also given them brains capable of penetrating and understanding them.

Elsewhere, however, Galileo wanted to make the point that just because a majority of the educated public shares a belief, the belief is not necessarily correct. When his purpose was to discredit majority opinion, then, he argued that sound reason is rare. Responding further to Sarsi's parade of witnesses, for instance, he writes in The Assayer (1957a, p. 271),

> Even in conclusions which can be known only by reasoning, I say that the testimony of many has little more value than that of few, since the number of people who reason well in complicated matters is much smaller than that of those who reason badly. If reasoning were like hauling I should agree that several reasoners would be worth more than one, just as several horses can haul more sacks of grain than one can. But reasoning is like racing and not like hauling, and a single Arabian steed can outrun a hundred plowhorses.

While he may have been equivocal about the extent and level of rationality among the general public, Galileo displays

nothing but contempt for those who have been blessed with a developed capacity to reason but refuse to recognize and exercise this providential gift. In the Letter to the Grand Duchess (1957b, pp. 183-184), he raps those who disregard evidence supporting the Copernican system because they read in the Bible that the sun moves and the earth stands still:

> I do not feel obliged to believe that that same God who has endowed us with senses, reason, and intellect has intended to forgo their use and by some other means to give us knowledge which we can attain by them. He would not require us to deny sense and reason in physical matters which are set before our eyes and minds by direct experience or necessary demonstrations.

Galileo's reference here to physical matters brings us to his concept of the natural world. In the Letters on Sunspots, written before his troubles with authorities, Galileo (1957c) personifies nature as a well-mannered lady who offers herself to mankind for study. He describes for his correspondent a simple method for observing sunspots, and rhapsodizes about how he has "been much impressed by the courtesy of nature" for arranging this means by which mankind can discover her mysteries. Using voyeuristic imagery, he writes, "For without any instruments, from any little hole through which sunlight passes, there emerges an image of the sun with its spots" (p. 116-117). Here, Galileo characterizes nature as playing an active role in her intercourse with man: "I might add that nature has been so kind that for our

instruction she has sometimes marked the sun with a spot so large and dark as to be seen merely by the naked eye" (p. 117).

But while nature gracefully exhibits herself before man's gaze, she remains aloof--and this is precisely what renders her reliable, predictable, and understandable. Galileo (1957c, p. 136) writes in a subsequent letter to the same correspondent, "Nature, deaf to our entreaties, will not alter or change the course of her effects; and those things that we are here trying to investigate have not just occurred once and then vanished, but have always proceeded and will always proceed in the same style."

This concept of the natural world as remote but scientifically accessible is reflected in a second metaphor Galileo uses to talk about nature, "the grand book of the universe" (see, for example, 1957c, p. 127). While the metaphor of nature-as-a-book appears throughout his writings, it is most fully developed in the Letter to the Grand Duchess, where his references to nature take place in the context of his repudiation of another book--the Bible--as a source of information about the physical universe. Echoing the shift in metaphor from woman to book, the tone shifts from one of nature as warm and sensuous to one of nature as majestic and impersonal. Nature is the "executrix of God's commands...[I]nexorable and immutable[,] she never transgresses the laws imposed upon her, or cares a whit whether her abstruse reasons and methods of operation are understandable to men" (Galileo, 1957b, p. 182).

In rejecting biblical exegesis as an appropriate way of

studying nature, Galileo (1957b, p. 183) approvingly quotes the theologian Tertullian: "God is known first through Nature, and then again, more particularly, by doctrine; by Nature in His works, and by doctrine in His revealed word." For Galileo, then, nature is one of a paired set of sacred texts. God reveals himself to mankind through his own inscription--nature--and through the writings of his agents--the Bible. These books correspond to two different realms of human experience, knowledge and faith, and are accessible through two different epistemological lenses, science and religion. While Galileo's understanding of the dimensions of science and religion, and knowledge and faith, are tightly interwoven, we will emphasize his conception of science as a realm apart from religion before considering his theory of knowledge.

The sixteenth century was a period of transition, in which it became increasingly difficult to harmonize new knowledge about the physical universe with the medieval worldview elaborated by Aquinas. The Renaissance and Reformation involved fundamental shifts in philosophy, religion, and the arts, but the era of scientific achievement was just beginning. Taylor (1938, p. 3) describes the sixteenth century as a time when the world "was growing out of its mental garments" as discoveries in astronomy, anatomy, chemistry, and geography were painfully squeezed into the corset of received doctrine. While scientific advances inevitably raised questions about the existing static worldview, it was not seriously challenged until Galileo. Taylor (1938, p.

4) writes, "Attacks on the ancients, and especially Aristotle, thus became more frequent, but their importance must not be over-estimated. Aristotle might be attacked by a few of the learned, but none the less his ideas were taught in every university as the beginning and end of science."

Galileo's contribution was to tear apart the seamless fabric of traditional cosmology, and to open up science not only to the accommodation of, but search for, new knowledge. His Letter to the Grand Duchess is a dazzling disengagement of science from religion. The gist of Galileo's argument against the charge that the Copernican system contradicts the scriptures is that Copernicus never trespassed into the realm of religion, and the Holy Fathers never trespassed into the realm of science. He writes (Galileo, 1957b, p. 179),

> Copernicus never discusses matters of religion or faith, nor does he use arguments that depend in any way upon the authority of sacred writings which he might have interpreted erroneously. He stands always upon physical conclusions pertaining to the celestial motions, and deals with them by astronomical and geometrical demonstrations, founded primarily upon sense experiences and very exact observations.

The Bible, on the other hand, may include allusions to physical matters, but they are allegorical and incidental to the primary purpose of sacred writings, "the service of God and the salvation of souls" (Galileo, 1957b, p. 182). Galileo (1957b, p. 183)

writes, "I should judge that the authority of the Bible was designed to persuade men of those articles and propositions which, surpassing all human reasoning, could not be made credible by science, or by any other means than through the very mouth of the Holy Spirit." Or as Galileo (1957b, p. 186) puts it later in the Letter to the Grand Duchess, "The intention of the Holy Ghost is to teach us how one goes to heaven, not how heaven goes."

In his own quest to learn "how heaven goes," Galileo developed the distinctive scientific method of observation and experimentation, expressed in the language of mathematics. His adamant insistence on the need to ground knowledge in empirical reality is obvious in the following passage from The Assayer (1957c, pp. 237-238):

> In Sarsi I seem to discern the firm belief that in philosophizing one must support oneself upon the opinion of some celebrated author, as if our minds ought to remain completely sterile and barren unless wedded to the reasoning of some other person. Possibly he thinks that philosophy is a book of fiction by some writer, like the Iliad or Orlando Furioso, productions in which the least important thing is whether what is written there is true. Well, Sarsi, that is not how matters stand. Philosophy is written in this grand book, the universe, which stands continually open to our gaze.

The most important aspect of Galileo's theory of knowledge

for our purposes is his understanding of the tentative nature of truth. A central theme that runs throughout the Letter to the Grand Duchess is Galileo's assertion, for which he draws support from Augustine and other theologians, that it is dangerous to cling dogmatically to existing interpretations of Biblical references to nature. As human knowledge of the physical world expands, it is bound to conflict with certain passages in the Bible. The Church can only survive the expansion of human knowledge if it is flexible and open to new ways of seeing. Galileo (1957b, p. 187) writes,

> I should think it would be the part of prudence not to permit anyone to usurp scriptural texts and force them in some way to maintain any physical conclusion to be true, when at some future time the senses and demonstrative or necessary reasons may show the contrary. Who indeed will set bounds to human ingenuity? Who will assert that everything in the universe capable of being perceived is already discovered and known? Let us rather confess quite truly that "Those truths which we know are very few in comparison with those which we do not know."

For Galileo, the provisional nature of human knowledge imposes a set of demands on the scholar who searches for truth. He must be intellectually curious, eager to learn, and willing to modify his beliefs as he discovers new information. Galileo tells a delightful parable in The Assayer (1957c, pp. 256-258)

about a man who raises birds for a pastime. He is enchanted with their ability to sing, and one night he happens to hear the delicate sounds of an unfamiliar species. On tracking it down, the song turns out to be that of a shepherd boy playing a flute. Impelled by his curiosity, the man travels about and encounters any number of objects and forms of life that produce pleasant tones--from stringed instruments to gate hinges to mosquitoes. But the more the man learns, the deeper he plunges into a sense of his own ignorance. Finally, he captures a cicada, and in the process of trying to discover where its song originates, he accidentally kills it. Galileo (p. 258) concludes, "And by this experience his knowledge was reduced to diffidence, so that when asked how sounds were created he used to answer tolerantly that although he knew a few ways, he was sure that many more existed which were not only unknown but unknowable."

The moral of the story, then, is that nature is infinitely varied and complex, and that mankind's understanding of the natural world is always incomplete. But the continuous search for more precise, complete, and accurate explanations requires more than an insatiable curiousity and keen mind on the part of the individual scholar. It demands tolerance on the part of authorities, the literate public, and learned scholars. Galileo's insistence on the need for free inquiry is clear when he writes in the Letter to the Grand Duchess (1957b, p. 187) that no one

...should close the road to free philosophizing about

> mundane and physical things, as if everything had already been discovered and revealed with certainty. Nor should it be considered rash not to be satisfied with those opinions which have become common. No one should be scorned in physical disputes for not holding to the opinions which happen to please other people best.

Galileo (1957b, p. 193) argues that for theologians to command astronomers to refute their observations and proofs is to enjoin the impossible: "For this would amount to commanding that they must not see what they see and must not understand what they know, and that in searching they must find the opposite of what they actually encounter."

Galileo's vision of the scientist as an inquisitive, committed seeker of truth and his conception of the unfolding, tentative nature of all human knowledge constitute the basis for his conviction that a free exchange of information and ideas is critical to the understanding of nature. Perhaps his most explicit pleas for freedom of expression were issued in the Letter to the Grand Duchess (1957b, pp. 205-206), where he urges theologians who are considering the question of the mobility of the earth to listen to "the experiences, observations, arguments, and proofs of philosophers and astronomers on both sides" before making a decision. A position should not be taken on physical problems or logical dilemmas, he contends, "without minutely airing and discussing all the arguments on both sides." Sounding

very much like the eighteenth century political liberals whose philosophy he adumbrates, Galileo writes that dignity is best secured by those who "do not demand that one opinion or another be prohibited, but merely ask the right to propose things for consideration which may the better guarantee the soundest decision."

Galileo, of course, confined his concerns to physical reality. The application of reason in the seventeenth century to the physical world would be extended in the eighteenth century, first to the mental world, and then to the social-political world (see Cassirer, 1951). In several respects, most obviously his loyalty to the Church, Galileo's worldview is distinctly premodern. The notion of progress is only faintly visible in his work, and the possibility of the control or conquest of nature is totally unexplored. Still, many of the principles first articulated by Galileo are now deeply ingrained ideals of Western culture. Religious fundamentalism and the more nihilistic strains of postmodernism are two challenges that now face freedome of expression. As Western intellectuals struggle to understand how to think about Enlightenment ideals in the late twentieth century, Galileo's courageous story reminds us of their original price.

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